MOTOROLA
intelligence everywhere™

PRO2150™ Portable Radio

Detailed Service Manual

User Safety, Training, and General Information v

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User Safety, Training, and General Information

Product Safety and RF Exposure Compliance

CAUTION: Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 68P81095C98) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/cgiss/index.shtml.

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Chapter 1 Introduction

1.1 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete Manual revision or alternatively as additions.

NOTE: Before operating or testing these units, please read the User Safety, Training and General Information Section in the front of this manual.

1.2 Warranty and Service Support

Motorola offers long term support for its products. This support includes repair of the product during the warranty period, and service/repair or spare parts support out of warranty.

Motorola de Colombia Service Center

Carrera 7 No. 71-52

Torre B, Piso 13

Oficina 1301

Bogota - Colombia

Phone: 571-376-6990

Motorola de Mexico Service Center

Bosques de Alisos #125

Col. Bosques de las Lomas

CP 05120 Mexico D.F.

Phone: 525-257-6700

1.2.1 Warranty Period and Return Instructions

Where the product is covered under warranty, a check of the product should be performed prior to shipping the unit. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

1.2.2 After Warranty Period

After the Warranty period, Motorola continues to support its products in two ways.

1. Motorola’s authorized service centers offer a repair service to both end users and dealers at competitive prices.
2. AAD supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

1.2.3 Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola's Accessories and Aftermarket Division (AAD). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

All orders for parts/information should include the complete Motorola identification number. All part orders should be directed to your local AAD office. Please refer to your latest price pages.

To order parts in Latin America and the Caribbean:

7:00 a.m. to 7:00 p.m. (Central Standard Time)

Monday through Friday (Chicago, USA)

1-847-538-8023

Motorola Parts (Accessories and Aftermarket Division AAD):

Attention: Order Processing

1313 E. Algonquin Road

Schaumburg, IL 60196

1.2.4 Technical Support

https://businessonline.motorola.com

Select: "Contact Us"

1.2.5 Parts Identification

1-847-538-0021 (Voice)

1-847-538-8194 (Fax)

1.3 Radio Model Information

The model number and serial number are located on a label attached to the back of your radio. You can determine the RF output power, frequency band, protocols, and physical packages. The example below shows one portable radio model number and its specific characteristics.

Table 1-1. Radio Model Number (Example: LAH49KDH8AA9)

	Type of Unit	Model Series	Frequency Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level
LA	H	49	K (136-174 MHz)	D 5W	H Full Keypad with Display	8 12.5/25K	AA Conventional	9 Full Keypad
			Q (403-440 MHz)	C 4W				
			R (435-480 MHz)					

H = Portable

Motorola Internal Use

1.4 Radio Features

Feature	PRO2150	
	CPS	User
Accessibility	**Yes**	Yes
Normal Operation		
Rx/Tx	X	X
Cloning	X	X
Factory Reset	X	
VFO	X	
Squelch Level	X	X
Scan List 1	X	X
Scan List 2	X	X
Scan List 3	X	X
Special PL 1,2,3	X	
Norm/Inv DPL	X	
TOT	X	X
Battery Saver	X	X
Battery Type	X	X
Alert Tone Volume	X	X
Prime Ch	X	X
Prime Ch Return Hang Time	X	
PTT ID (OFF, PRE, POST, BOTH)	X	
PTT ID Sidetone	X	
PTT Short Sidetone	X	
Tx Pretime	X	
Backlight Status	X	X
PTT ID	X	
Button Programmability	X	
Access/Deaccess Code	X	X
Telephone No	X	X
PL/DPL Type	X	
Scan Interval Timer	X	
Scan Hang Timer	X	
Channel On/Off	X	
Rx Freq	X	
Tx Freq	X	
Rx PL/DPL	X	

Feature	PRO2150	
	CPS	User
Tx PL/DPL	X	
TOC	X	
Power Level	X	
BCL	X	
Ch Alias	X	
Ch Spacing	X	
PTT ID On/Off	X	
PL Required for Selcall	X	
Scan Type Select	X	
Scan List Select	X	
Copy Ch	X	
Scan Lower Limit	X	
Scan Upper Limit	X	
Freq Step Size	X	
Rx Freq	X	
Tx Freq	X	
Offset Freq	X	
Repeater Offset	X	
Rx PL/DPL	X	
Tx PL/DPL	X	
TOC	X	
Power Level	X	
BCL	X	
Ch Spacing	X	
PTT ID On/Off	X	
Radio Information	X	X
Radio Configuration	X	X
Conventional Personality	X	X
VFO Status	X	
Scan List	X	X
Phone Information	X	X
Signalling	X	X
Programmable Button	X	X
Reverse Burst	X	

X = Indicates available
Blank = Indicates unavailable

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Chapter 2 Maintenance

2.1 Introduction

This chapter provides details about the following:

- Preventive Maintenance
- Safe Handling of CMOS and LDMOS Devices
- General Repair Procedures and Techniques
- Disassembling and Reassembling the Radio

2.2 Preventive Maintenance

The radio does not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

2.2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

2.2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

NOTE: Internal surfaces should be cleaned only when the radio is disassembled for service or repair.

The only recommended agent for cleaning external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning printed circuit boards and their components is isopropyl alcohol (70% by volume).

CAUTION: The effects of certain chemicals and their vapors can have harmful results on certain plastics. Avoid using aerosol sprays, tuner cleaners, and other chemicals.

2.2.2.1 Cleaning External Plastic Surfaces

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. Use a soft, absorbent, lintless cloth or tissue to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

2.2.2.2 Cleaning Internal Circuit Boards and Components

Apply Isopropyl alcohol (70%) with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE: Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

2.3 Safe Handling of CMOS and LDMOS Devices

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the following CAUTION statement.

CAUTION: This radio contains static-sensitive devices. Do not open the radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number RSX-4015.)
- Do not wear nylon clothing while handling CMOS devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

2.4 Repair Procedures and Techniques — General

2.4.1 Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Communications parts center listed in the Piece Parts section of this manual.

2.4.2 Rigid Circuit Boards

This radio uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near the 20-pin and 40-pin connectors:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.

2.4.3 Flexible Circuits

The flexible circuits are made from a different material than the rigid boards, and require different soldering techniques. Excessive prolonged heat on a flexible circuit can damage the material. Therefore, avoid excessive heat and excessive bending.

For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600-700 degree F tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat to be applied to the circuit.

To replace a component on a flexible circuit:

1. Grasp with seizers (hemostats) the edge of the flexible circuit near the part to be removed.
2. Pull gently.
3. Apply the tip of the soldering iron to the component connections while pulling with the seizers.

NOTE: Do not attempt to puddle-out components. Prolonged application of heat may damage the flexible circuit.

2.4.4 Chip Components

Use either the RLN-4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 700 degrees F. (370 degrees C), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- To remove a chip component, select a hot-air hand piece and position the nozzle of the hand piece approximately 1/8” above the component to be removed. Begin applying hot air. Once the solder reflows, remove the component using a pair of tweezers. Using solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.
- To replace a chip component using a soldering iron, select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads. Using a pair of tweezers, position the new chip component in place while heating the fresh solder. Once solder wicks onto the new component, remove the heat from the solder. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- To replace a chip component using hot air, select the hot-air hand piece and reflow the solder on the solder pads to smooth it. Apply a drop of solder paste flux to each pad. using a pair of tweezers, position the new component in place. Position the hot-air hand piece approximately 1/8” above the component and begin applying heat. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

2.4.5 Shields

Removing and replacing shields will be done with the R-1070 station with the temperature control set to approximately 415°F (215°C); 445°F (230°C) max.

- To remove the shield, place the circuit board in the R-1070's holder. Select the proper heat focus head and attach it to the heater chimney. Add solder paste flux around the base of the shield. Position the shield under the heat-focus head. Lower the vacuum tip and attach it to the shield by turning on the vacuum pump. Lower the focus head until it is approximately 1/8" (0.3cm) above the shield. Turn on the heater and wait until the shield lifts off the circuit board. Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump. Remove the circuit board from the R-1070's circuit board holder.
- To replace the shield, add solder to the shield if necessary, using a micro-tipped soldering iron. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board. Place the circuit board back in the R1070's circuit board holder. Place the shield on the circuit board using a pair of tweezers. Position the heat-focus head over the shield and lower it to approximately 1/8" above the shield. Turn on the heater and wait for the solder to reflow.
  Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

2.5 Disassembling and Reassembling the Radio — General

Since these radios may be disassembled and reassembled with the use of only four (board to casting) screws, it is important to pay particular attention to the snaps and tabs, and how parts align with each other.

The following tools are required for disassembling the radio:

- Phillips screwdriver
- 4mm socket wrench

If a unit requires more complete testing or service than is customarily performed at the basic level, send this unit to a Motorola Authorized Service Center.

2.6 Radio Disassembly — Detailed

2.6.1 Front Cover from Chassis Disassembly

1. Turn off the radio.
2. Remove the battery:
   a. Slide the battery clasp away from the radio (See Figure 2-1.).

Figure 2-1.

   b. Slide battery down and away from radio.
3. Remove the antenna.
4. Pull the On/Off Volume knob off of its shaft.
5. Remove the two screws at the back of the rear chassis (See Figure 2-2.).

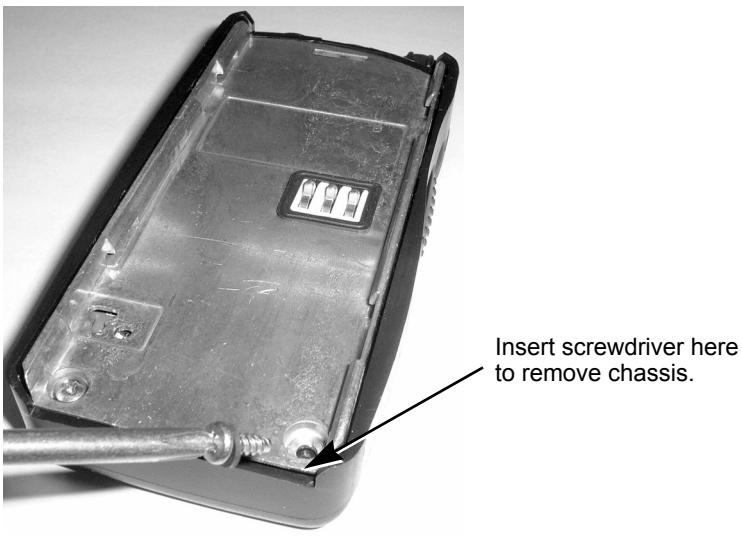

Figure 2-2.

6. Insert a small flat-head screwdriver at the bottom of the radio, between the chassis and housing (location marked in Figure 2-2), and lift the chassis gently. Be careful not to damage the housing or the O-ring underneath.

7. Lift the rear chassis away from the front cover (See Figure 2-3.). Be careful not to damage the speaker wire underneath.

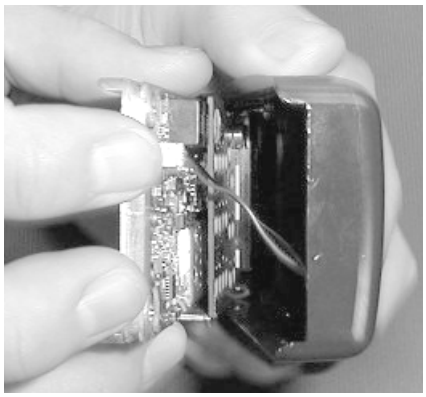

Figure 2-3.

8. Slide the rear chassis downwards, and away from the front cover.
9. Remove the speaker connector, which connects between RF Board and the internal speaker on the front cover (See Figure 2-4.).

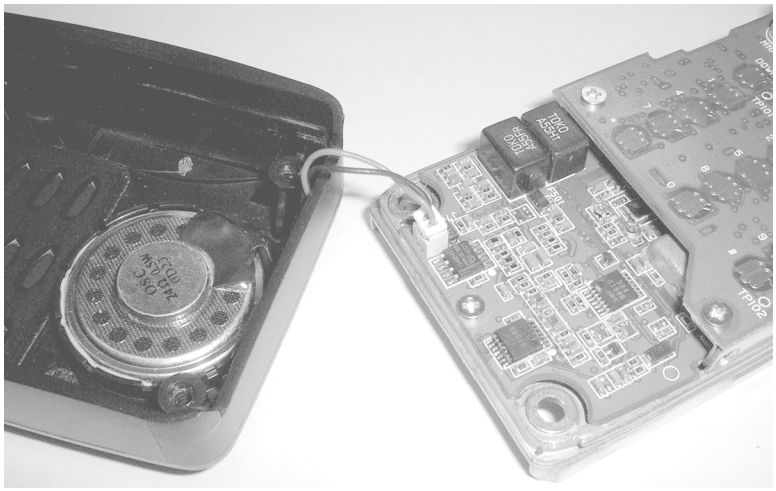

Figure 2-4.

2.6.2 Control Board Disassembly

1. Remove the screws which hold the control board to the RF board.
2. Remove the control board which is connected to the RF board through a board-to-board connector (See Figure 2-5.).

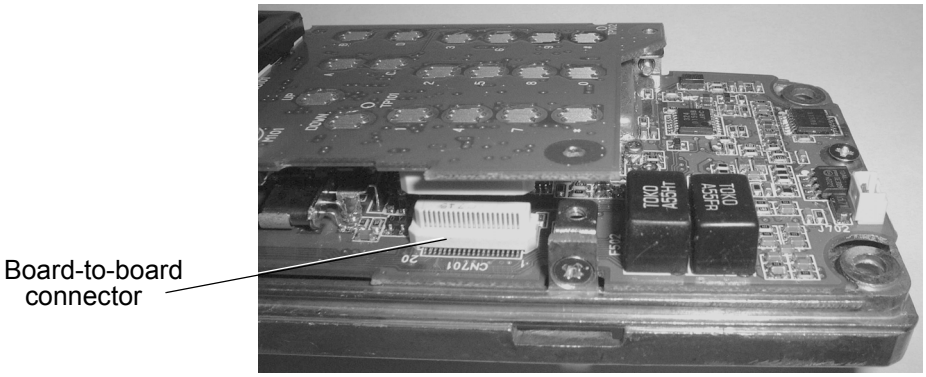

Figure 2-5.

2.6.3 RF Board Disassembly

1. Remove the screws and the stud which hold the RF board to the rear diecast with the Phillips head screwdriver and socket wrench respectively.
2. Gently remove the RF board from rear diecast. The completely disassembled radio is shown in Figure 2-6.

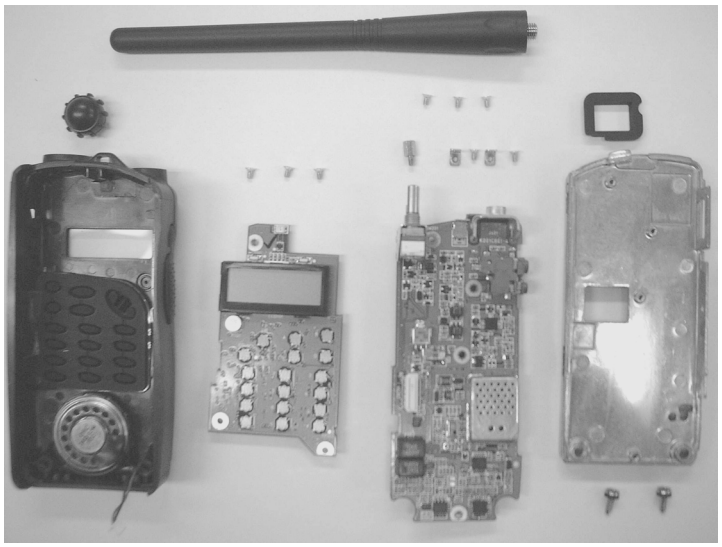

Figure 2-6.

NOTE: The Control and RF boards are mounted with cross recess screws meeting the Phillips Cross Slot number 1 standard. Using a Phillips 0 will damage the screw recesses as will a poorly fitting Phillips 1 screwdriver. One example of a correct fitting screwdriver is manufactured by PB Baumann (http://www.pbtools.ch/index_e.html) and is available from many electronic tool dealers. The PB Baumann item number is 121/1-70. Other high quality manufacturer's pruducts meeting the Phillips 1 standard are also acceptable.

2.7 Radio Reassembly — Detailed

2.7.1 RF Board Reassembly

1. Place the RF board on the rear diecast.
2. Tighten the screws and the stud.

2.7.2 Control Board Reassembly

1. Place the control board on the RF board.
2. Connect the control board to the RF board by pressing it firmly downwards at the board-to-board connector (See Figure 2-7.).

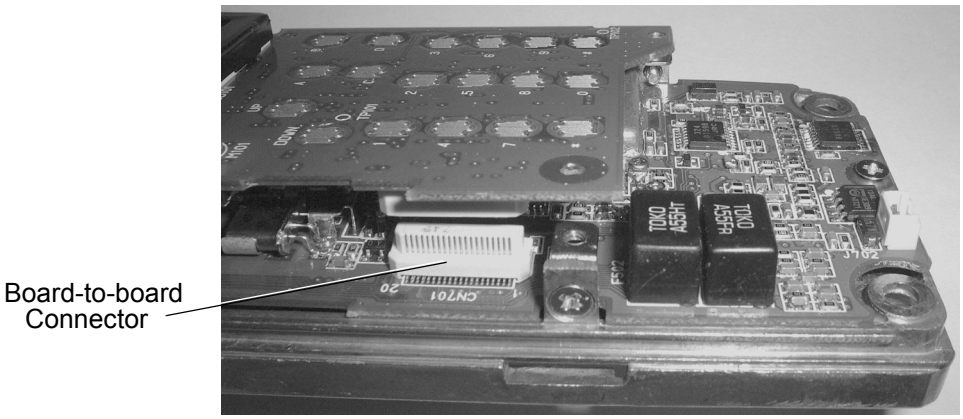

Figure 2-7.

3. Tighten the screws using a screwdriver to hold the control board in place.

2.7.3 Chassis and Front Cover Reassembly

1. Remove the metal retainer with a small flat head screwdriver (See Figure 2-11.).

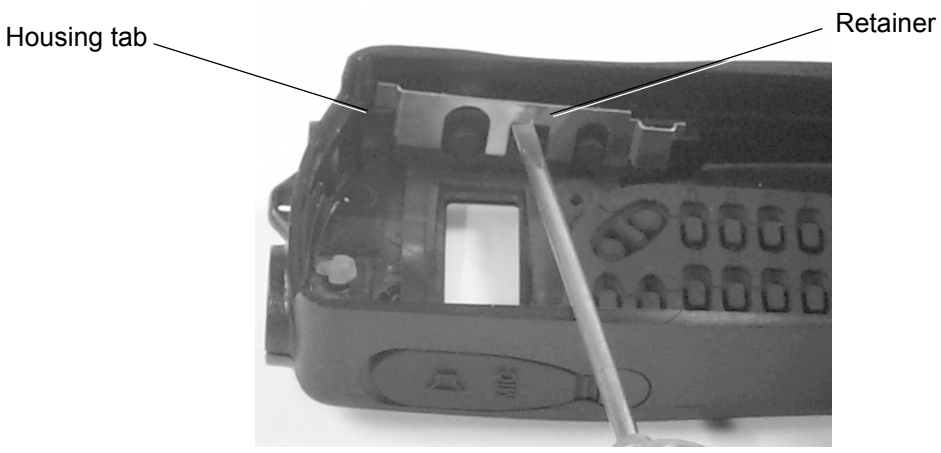

Figure 2-8.